FALSIFICATIONS IN THE HISTORY OF EARLY CHEMISTRY

By Professor J. M. STILLMAN
STANFORD UNIVERSITY

THE earliest developments of any science present difficulty to historians by reason of the fragmentary character of surviving records, but with the progress of time and the advance of research the story becomes gradually clearer and more coherent. In the case of the history of the science of chemistry, however, more perhaps than in any other, factors have been operative that have made peculiarly difficult the solution of the problems of its early history.

The beginnings of the history of chemical theory, the notions of the nature of matter and its changes are found in the Greek philosophers from Thales to Aristotle, and for our knowledge of these we are mainly dependent on the records of Plato and Aristotle.

For our knowledge of the earliest data on the practical arts of chemistry we are in the first instance dependent upon evidence accumulated by archeological research with respect to remains of works of art or manufactures involving chemical knowledge or skill; in the second instance, to surviving documentary records of ancient times of established authenticity.

Such in the domain of chemistry are, particularly, Theophrastos of Eresus (born 371 B. C.), Pollio Vitruvius (1st century B. C.), Dioscrides and Pliny the Elder (first century A. D). These writers were, however, not chemists by occupation or by experience.

The earliest practitioners of the chemical arts of whom we have some definite knowledge appear to have been Egyptian or Greek-Egyptian practitioners of the arts of metal working, goldsmiths and dyers. These arts seem to have been long held as a monopoly by a certain cult of the Egyptian priesthood, and these arts had been guarded and kept secret, only imparted to initiates bound by solemn oaths not to reveal them to the uninitiated.

The first recognition of this chemical cult and the philosophy developed by it connects with the Greek-Egyptian schools at Alexandria early in the Christian Era. The art called by the early Alexandrian writers the sacred or the divine art became only

gradually more widely known through the destruction of the pagan temples and schools, and the scattering of their scholars, by the early Christians.

The earliest known designation of this Greek-Egyptian art which gave rise to our word chemistry is the Greek word chemeia and is first met with in the third century of our era in writings of a Christianized Alexandrian, Zosimus, who endeavors to explain the origin of the term by a fabulous myth. The term is also met with in the same century in the decree of the Emperor Diocletian against the practice of this art of chemeia and ordering the destruction of all works relating thereto. This decree was issued, it appears, on account of the belief that these chemists were able to make artificial gold and silver and that thereby the finances of the empire might be seriously disturbed.

With the abolition of the Alexandrian and other pagan schools and the downfall of the Egyptian priesthood, their chemical arts as practiced were indeed not lost, though their practitioners were scattered. The early scholars of this chemical cult did not write for the public. Those who in time ventured to write about the sacred art, either by reason of their desire not to be considered as violating their oaths of secrecy, or for fear of not being thought good Christians, wrote in obscure and mystical allegories or in vague descriptions of, or allusions to, processes which generally centered about the transmutations of base metals to precious metals, or the preparation of elixirs and the philosopher's stone. With the increase of power of the Christian Church there seems to have been a decline of interest in Western Europe in this phase of Alexandrian chemical philosophy, though in Byzantium there seems to have been a cult which kept alive to some extent those traditions and ideas and preserved such writings as then existed.

With the rise of the Moslem power and their conquests of Persia, Asia Minor, Egypt, Morocco and Spain in the sixth to the eighth centuries, the Arabs absorbed and assimilated the Greek Alexandrian science, which had been preserved and cultivated notably by Syrian schools founded by fugitive scholars from Alexandria and other suppressed pagan schools. This Greek science of chemeia thus became known as al-chemia, under which name it was in the eleventh to the thirteenth centuries again introduced to western Europe, largely through the medium of Christian scholars from Spain, Italy and other nations who studied at the Spanish Mohammedan schools.

This re-introduction into Europe of Arabian elaborations of Greek-Egyptian alchemy was not without serious opposition. It was very generally believed that the alchemists possessed the power

to make gold and silver from base metals, and hence their activities were viewed with suspicion by civil and ecclesiastical authorities who feared that state or national finances might be disturbed. Monarchs of France and of England and other lesser rulers, and in the fourteenth century Pope John XXII forbade under penalties the practice of alchemy and the possession of alchemical literature. As the practice of alchemy was often associated with supposed magical powers and the cooperation of evil spirits, church authorities, both Christian and Mohammedan, endeavored to suppress alchemists and their writings.

One natural result of this situation was to discourage conservative and law-abiding persons of scholarly taste from entering this field of science. Another result was to cause those who nevertheless refused to heed the prohibition decrees either to exercise great caution in their expressions or to conceal their identity as authors.

There were numerous such alchemical writers, for the administrative machinery was notoriously defective in those times and the hope of gain in wealth or long life of many influential and powerful persons—even princes—often operated to protect many who pretended to possess the great art.

Thus in the middle ages, while there were written a very large number of treatises on alchemical philosophy or pretending to the knowledge of transmutation or to give instruction in the art, such writings were nearly always anonymous or pseudonymous. The authors concealed their personal identity by issuing their manuscripts without name, place or date, by giving false dates and places, or to give their writing greater importance by ascribing them to some author of established authority in some natural science, safely dead.

During this period also the literature of technical chemistry outside of the domain of alchemy proper was very meager. The artisans and manufacturers were not generally scholars. They had also little object in informing the public generally as to the details of their business. So far as writings of that character were issued, they were for the use of a limited constituency and attracted little notice outside of the particular trade for which they had practical value. Such manuscripts were rarely preserved in permanent collections or libraries.

From these causes it can be understood that the history of chemistry in the middle ages presents peculiar difficulties, and that surviving records give occasion for many perversions of history. An early instance of such perversion is found in early writings issued under the name of Democritus and generally attributed to the Greek

philosopher Democritus of Abdera (5th Century B. C.). The writings in question, however, are typical alchemical of the Alexandrian school. While they contain recipes for making imitations of gold and silver, and for dyes and dyeing, etc., they contain also much mystical philosophy and obscure allegories. Even Pliny, about 75 A. D., refers to magical and superstitious writing of Democritus, and expresses the belief that they are by Democritus of Abdera, though he admits that that is disputed by others. Pliny's contemporary, Columella, however, asserts that much that is attributed to Democritus was in reality written by a certain Bolos of Mendes in Egypt. This psuedo-Democritus was held in the highest reverence by later alchemists and by them generally considered as Democritus of Abdera. Zosimus about the third century A. D. refers to him as a great master of the art. So late as the eighteenth century Lenglet du Fresnoy in his history of alchemy assumes that Democritus of Abdera is the author of this literature, though by later historians it is well recognized that the alchemist Democritus is a writer of between the first and third centuries of our era.

Even Aristotle was the victim of medieval impostors. Thus the work on minerals—*de mineralibus*—attributed to him seems to have been originally written by a Syrian-Arabian writer of about the ninth century, though rewritten and extended by later Latin editors. According to Ruska it is the earliest Arabian work on mineralogy and was a principal source of medieval mineralogy. Other works falsely attributed to Aristotle are not earlier than the 11th century and some much later.

So also the eminent Arabian physicians, Rhazes (Al Razi) of the 9th-10th centuries and Avicenna (Ibn Sina) of the 10th-11th centuries, were fraudulently credited with works of alchemical character of a century or so after their deaths, which were much quoted by Vincent of Beauvais, Albertus Magnus and Roger Bacon in the thirteenth century. These writing are now believed to have had no Arabian originals but to have been written by Latin writers in the 12th and 13th centuries.

A notable perversion of history was the appearance about 1300 A. D. of certain writings important in the history of chemistry purporting to be the work of the Arabian Geber, which was the Latinized name of Djaber. The real Djaber lived probably about the eighth century, and little is known of his personality. He is, however, considered by later Arabian alchemists as of high repute in the art. His writings seem to have been unknown to European chemists during the medieval period. Though his name appears two or three times among authorities of reputation, neither Vincent

of Beauvais nor Albertus Magnus seems to have known anything definite of his works. The works appearing under the name of Geber were very notable, and made a great impression in the fourteenth century. They were manifestly the work of an experienced and capable chemist familiar with and describing well methods of distillation, sublimation, many furnace operations and the preparation and purification of many metallic salts and solutions. They contained our first definite information concerning the preparation and use of mineral acids—sharp or corrosive "waters." The credulous middle ages accepted generally without question the authenticity of these works as by the eighth century Geber, and the early historians of chemistry, Hoefer, Gmelin, Kopp, accepted this interpretation. Kopp indeed in his "Geschichte der Chemie" expressed some doubts, but did not, however, alter the traditional course of history. In his later work, however—"Beiträge zur Geschichte der Chemische"—he gives strong reasons for doubting the early date of these writings and that they were indeed translations from any Arabian originals. It remained for M. Berthelot to establish beyond doubt the pseudonymous character of these writings. In the libraries of Europe he located and had translated a number of works, manuscripts in Arabic credited to the original Djaber or Geber. None of these works bore any resemblance in style or contents to the work of the Pseudo-Geber. They are indeed much more like the writings of the early Greek alchemical writings upon which they are manifestly based.

The acceptance of these thirteenth or fourteenth century writings as of Arabian origin in the eighth century up to very recent times has had the result of early Arabian chemists receiving credit for an advanced knowledge of chemistry which has not been evidenced by any Arabian literature known at the present time. This advanced knowledge is rather to be credited to some European chemists, probably both Mohammedans and Christians, of the latter part of the thirteenth century, and the Pseudo-Geber was probably not himself Arabian but a Latin-writing Spaniard or at any rate from some other country of southern Europe conversant with the development of Spanish-Arabian chemistry of that period.

The chemical literature of the fourteenth and fifteenth century contains almost nothing that evidences any material advance upon the Pseudo-Geber and his predecessors. Alchemical treatises of that period are indeed numerous. They are, however, nearly all anonymous, or pseudonymous. Many were ascribed to the authorship of prominent writers deceased. Many were ascribed to eminent churchmen—Albertus Magnus, St. Thomas Aquinas, Raimundus Lullus (Lully) and Roger Bacon. In the case of Albertus

Magnus, two alchemical papers attributed to him are included in the collection of his works published by the French government, though the principal one of these contains references to authorities long subsequent to his death. The judgment of recent students of chemical literature, on the basis both of internal and external evidence is that all alchemical literature attributed to Albertus, St. Thomas Aquinas and Lullus are the work of impostors of from a half-century to perhaps two centuries later. In the case of Roger Bacon, while there are genuine writings in which he talks about alchemy and expresses his faith in some of its claims, it appears quite certain that those writings which pretend to a personal experience in the alchemist's arts are all falsely attributed to him.

Raimundus Lullus was a prominent churchman and writer on theology and philosophy at the close of the thirteenth century who was killed at Tunis in 1315 while carrying on missionary work among the Moors. He was reputed as a great master of alchemy in the later middle ages, and a considerable alchemical literature exists under his name. His scholarly biographer, B. Haureau, cites the titles of some eighty alchemical treatises—printed or not—which are attributed to him, yet it seems well established that he wrote nothing of that kind. Several of the most popular and apparently earlier works are circumstantially dated between 1330 and 1333, and even these there are reasons to believe are antedated. The alchemical literature attributed to Lullus is probably not earlier than the middle of the fourteenth century and much of it later. It is also very probable that most if not all the alchemical treatises ascribed to the Spanish physician, Arnald of Villanova, another eminent authority with medieval alchemists, is apocryphal.

The early part of the sixteenth century is marked by three writers of note in the history of chemistry, Theophrastus von Hohenheim, called Paracelsus (1493-1541), Vannuccio Biringuccio (his single book on mining and metallurgy was published 1540) and George Bauer or Agricola (1494-1555). The well-known works of these authors were widely appreciated by their century, were printed and passed through many editions and translations. The works of Biringuccio and Agricola were both important technical treatises appealing mainly to mining and metallurgical coworkers. The works of Paracelsus were medical and chemical and dealt in his peculiar way with natural philosophy in general and attracted great attention on account of his emphasis upon the place of chemistry in medicine.

At the close of the sixteenth century and early in the seventeenth, there appeared certain treatises, printed in German, published by Johann Thölde, said by him to be translations of ancient

Latin manuscripts, and to have been written by an alleged Benedictine monk—Basilius Valentinus. The works attributed to Basilius attracted wide attention. They were a strange mixture of alchemical lucubration and of advanced chemical knowledge. They dealt with the importance of chemistry in medicine, and with chemical medicines. They criticized severely the medical profession. In all this they resembled the literature of Paracelsus. Moreover, the theory of the *tria prima,* of salt, sulphur and mercury as the constituent principles of all material substances, a theory which Paracelsus had formulated and much reiterated, was found just as clearly stated. Many passages were so similar in the writings of the two that students were not slow to infer that one author must have copied his ideas from the other. Much speculation and controversy was excited as to date and authorship of the Basilius literature, but eventually the seventeenth and eighteenth centuries accepted it as of the late fifteenth century and therefore pre-Paracelsan. To be sure, the archives of the Benedictine order when searched revealed the name of no such member, nor was any reference to any such author or his works known previous to 1600. Nor was any such specific chemical knowledge as was contained in some of these works contained in earlier writings than of the sixteenth century. No original manuscripts from which these books were supposed to be translated were ever in evidence.

As the bitter war in the medical profession between the opponents and partisans of Paracelsus and the chemical medicines introduced by him was then at its height, and the conservative and more scholarly university faculties and the conservative party in the medical profession were antagonistic to Paracelsus, it is not improbable that there was a willingness on their part to believe that Paracelsus had borrowed from Basilius rather than the contrary. However that may be, the result was that the Basilius literature was quite generally accepted as of the latter part of the fifteenth century, and the earlier historians, as Gmelin, Kopp and Hoefer and their successors, generally adopted this assumption. At the same time these historians were skeptical as to the existence of the alleged Dominican monk of that name.

Kopp, who in his history of chemistry (1843-7) had accepted the fifteenth century as the period of these writings, in his later "Beiträge zur Geschichte der Chemie" (1875) presented strong evidence that the Basilius literature was not previous but subsequent to Paracelsus, and in his last work "Die Alchemie" (1886) he reiterates his belief in the fraudulent character of the work and that Thölde himself was the real author, a conclusion which later

researches have only confirmed. Prof. Karl Sudhoff, than whom no living scholar is more conversant with the medical literature of that period, stated in 1913 in a personal communication that after perusing thousands of manuscripts there is no possible room for doubt but that the Basilius literature as well as the Hollandus literature is all post-Paracelsan.

The works attributed to the alleged father and son Hollandus are of the same period as those of Basilius. The date of the first treatise published under the name of Johann Isaac Hollandus is 1572, at which time practically all the Paracelsus literature had been printed. The rest of the Hollandus literature was considerably later. These works also contain much that is similar to much in Paracelsus. The doctrine of the three principles was here also clearly stated. These writings also professed to be of earlier date and were accepted by the seventeenth and eighteenth centuries as also of the fifteenth century on no definite evidence. The works of the two Hollandus, whoever they were, and if there really were two, are of much less interest or value than some of the Basilius works, yet they contained also a great many chemical facts or points of view not known to the fifteenth century, and the incorporation of this literature into the fifteenth century history in the systematic histories of Gmelin, Thomson, Kopp and Hoefer caused a perversion of the story of chemistry, and gave an importance to these writers which they would not have received if they had been located in their proper chronological order. Not only did the sixteenth century chemists not depend on them, but the authors of the Basilius and Hollandus literature had or might have had the advantage of the works of Paracelsus, Biringuccio, Agricola and other less important chemists of the sixteenth century.

Works of alchemical character were also published under the name of George Agricola entirely foreign to his thought and easily recognized as spurious by the historians of chemistry. The literature of Paracelsus still presents unsolved and difficult problems as to authenticity in the great volume of works attributed to him and first published thirty to forty years after his death.

The foregoing sketch makes no pretension to a complete account of falsifications in the early history of chemistry, but comprises the most notable instances and will serve to illustrate the difficulties that have attended the story of the early development of chemical science and the misapprehensions affecting the reputations of early scholars in science.